PHYS 541 Radiative Processes

Spring 2017 Syllabus

Class website: http://spacibm.rice.edu/~liang/phys541

Instructor: Edison Liang, Room 342 Herman Brown Hall, x3524, email: liang@rice.edu

Office Hours: TuTh 2 - 4 pm, or by appointment

Class Time: TuTh 10:50 AM – 12:05 PM **Class Room:** 227 Herman Brown Hall

Textbooks:
Radiative Processes in Astrophysics, by George Rybicki and Alan Lightman (2004, Wiley paperback)
The Physics of Astrophysics Vol.1: Radiation, Frank Shu (2010, University Science Books Paperback)

Supplemental References:
1. Classical Theory of Fields, L. Landau & E. Lifshitz (Oxford)
2. Radiative Processes in Plasmas, G. Bekefi (Wiley)
3. Radiation Processes in Astrophysics, W. Tucker (MIT)
4. Electromagnetic Processes, R. Gould (Princeton)
5. Quantum Theory of Radiation, W. Heitler (Dover)
6. Radiation in Astrophysical Plasmas, V. Zheleznyakov (Kluwer)
7. Stellar Atmospheres, D. Mihalas (Freeman)
8. Classical Electrodynamics, J.D. Jackson (Wiley)

Grades :
60% Home Works, 40% Term Paper or Final Exam.
Home works are normally due 2 weeks after their assignment. Late home works will be discounted 25% for each lecture it is late, except for special hardship cases. Solutions will be posted on the class website after home works are graded.
Grader: TBD

Rice Honor Code:
Students are expected to uphold the Rice Honor Code. Students are allowed to work together on problem sets, but the submitted homeworks, term paper or final examination must be his/her own original work.

Course Objectives:
This is a course on the fundamental physics of electromagnetic radiation processes. It has broad applications to all branches of physics, from astrophysics and space physics, to nuclear and particle physics, AMO and medical physics. While the core material is based on the textbook by Rybicki and Lightman (R & L), I plan to reduce somewhat the mathematical rigor and lengthy derivations of classical electromagnetic theory of the R & L textbook, and

increase the discussion of quantum radiation processes and their applications. I may also generalize the medium from idealized plasmas to the interaction of radiation with neutral and condensed matter. Other topics may also be added after mutual decision by the students and instructor.

Learning Outcomes:
Students are expected to turn in one homework assignment every two weeks, which will be graded, and complete a term paper or final examination. Through home works, student should become fluent in solving problems in radiative processes and radiation transport, and master the key concepts of the textbooks and lecture material. The term paper will train students to develop skills in writing and literature search. If a final examination is chosen in lieu of the term paper, it will consist of both conceptual questions and computational problems.

Disability:
Any student with a documented disability that requires accommodation should contact both the course instructor and Disability Support Services in the Allen Center.

Tentative Topics and Number of Lectures

TOPIC	TENTATIVE NO. OF LECTURES	R & L Chapter
Introduction & organization	1	
Radiative transfer	2	1
Thermal radiation, diffusion, Einstein coefficients	1	1
Radiation Fields, polarization, Stokes parameters	2	2
Radiation from moving charges	2	3
Special Relativity	1	4
Bremsstrahlung (free-free) radiation	2	5
Synchrotron radiation	2	6
Thomson & Compton scattering	3	7
Pairs & high energy processes	1	
Plasma and other medium effects	1	8
Atomic structure	2	9
Radiative transitions, Rayleigh scattering	3	10
Molecular structure	1	11
Stimulated emission, coherent radiation	2	
Other optional topics (TBD)	1	